

Molecular Aspects of Polyethylene Wear by Soft X-ray Analysis

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Over half a million patients receive artificial joint replacements annually and practically all the replacements consist of a sliding pair represented by a polymer (ultra-high molecular weight polyethylene -UHMWPE) and a hard counter face (metal or ceramic). Sliding induced molecular orientation has been considered as a precursor to wear in UHMWPE. Minimizing the extent of orientation during sliding is thought to be key factors to minimize wear. Cross-linking reduces the mobility of molecules and hence increases the wear resistance of UHMWPE. Current methods of inferring or deducing orientation are not accurate and often rely on staining and cutting specimens. We utilized NEXAFS to determine the molecular orientation effects of cross-linking of ultra-high-molecular weight polyethylene (UHMWPE) and how this may change under actual and simulated testing conditions in a large range of industrially prepared samples from Howmedica.